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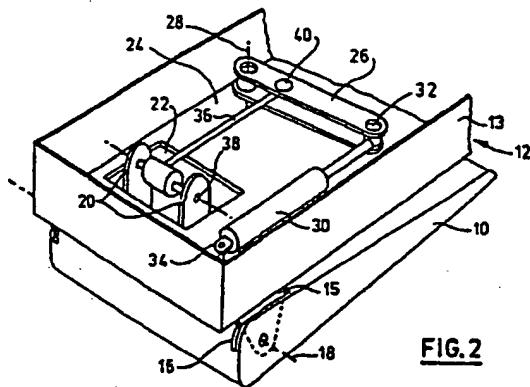
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⑩ Support apparatus.

⑩ A support for an object of appreciable weight (eg for a CRT display) comprises a mount 10 which, in use is located at a reference height. A crank 20 extends from this mount. A boom 12 is pivotally mounted on the mount and extends therefrom to and carries means (not shown) for attaching the intended object which is to be located at an adjustable height with respect to the reference height. A lift lever 26 and a gas strut 30 are carried wholly by the boom. A lift rod 36 is mounted between a position on the crank remote from the mount/boom axis 18 and the lift lever, the latter being pivotally mounted in the boom. The lift rod and the gas strut are connected to the lift lever. The gas strut engages the boom and counteracts the effects of gravity on the loaded support. The lift lever is arranged to rotate about an axis 28 which is substantially orthogonal to the mount/boom axis and is fixed relative to the boom. Alternatively, or in addition, the lift rod and the gas strut are arranged to be connected to the lift lever with the strut at a greater separation from the lever's pivot than the rod. In addition to the lift mechanism the support can also incorporate a parallel motion and a tilt mechanism.



SUPPORT APPARATUS

The present invention relates to a support for locating an object (or objects) of appreciable weight at an adjustable height.

There are a number of applications in which it is desirable to locate an object of appreciable weight at any height within a given range and to have it remain in position using a passive mechanism without the need for locking mechanisms which bear a substantial portion of that weight. One such application is the mounting of visual display units such as cathode ray tube (CRT) displays. For ergonomic reasons it is desirable to provide such displays with means for adjusting the height at which the screen is located so as to accommodate various users, lighting conditions, workstation layouts etc. Other such applications in an office environment would be the supporting of a drawing board, or of a complete workstation with keyboard and display.

If the weight of the object is negligible, the general stiffness of the mechanism will be sufficient to locate if not to preserve attitude, but, even with an apparently light item such as a CRT, the weight involved can typically be within the range of 8 Kg to 30 Kg for a single display.

A prior art support for a CRT display described in DE - B - 2847135 comprises a base mount, a boom pivotally mounted at its lower end to the base member, and means for attaching the display at the other end of the boom. In order to counteract the weight of the display, a torsion spring is provided at the lower pivot point of the lift boom to bias it towards its raised position. In view of the high lifting forces needed it is necessary to use relatively large and bulky torsion springs in the support. Also, due to the characteristic of a spring, there is a tendency for too high a lifting force to be provided at the lower positions of the boom and an insufficient lifting force to be provided at upper boom positions.

It is also known to use one or more gas struts to provide the required lifting force. Typically, in prior lifting apparatus, the gas struts have provided a direct lifting force.

In one type of arrangement the gas struts have been mounted vertically and the display is moved up and down on the struts. This vertical arrangement has the major disadvantage that a low positioning of the screen can only be achieved if the lifting mechanisms is mounted externally to the display, which increases the desk space or footprint needed, or if it penetrates the display itself, which makes for a more complicated design.

A second type of arrangement using gas struts can be compared to a support which uses torsion springs such as that shown in the aforementioned DE -B-2847153. In the arrangements of this second type, a gas strut has been directly connected between the base mount and the boom in such a way as to bias the boom into its raised position. The use of a boom does provide a greater range of available heights compared to the vertical motion arrangement, but because of the direct action, both types of arrangement require the use of powerful and bulky gas struts, which result in relatively bulky supports. Prior gas strut arrangements also suffer from the problem of providing the correct amount of lift throughout the full range of lift heights.

These prior arrangements all suffer from the disadvantage of requiring powerful biasing means which means that the assembly and/or repair of the apparatus is potentially hazardous and that the supports are commensurately bulky and expensive. In addition, even in the lowest position the equipment is still at a substantial distance above the desk.

In UK -A-2 021 065, a counterbalancing mechanism for X-ray tubeheads is disclosed. The mechanism comprises a hollow casing which is pivotally mounted to a trunnion at one end and to a triangular bracket at the other end. The triangular bracket also forms means for attaching the tube head. A bar is pivotally mounted to the trunnion and to the triangular bracket as well. In order to provide a counterbalancing force, a gas strut is connected between a position in the housing and the triangular bracket. This arrangement is, however, relatively bulky because the triangular bracket, rather than the casing, supports the tube head and, in addition, forms a lever in a lever mechanism, which results in a vertical disposition of the bar and strut being necessary.

A structure for supporting medicinal or data processing apparatus at an adjustable height below a ceiling is described in DE -A-3416823. The support comprises a ceiling mount, an arm pivotally connected to the ceiling mount and means pivotally connected to the arm for attaching the apparatus to be supported. The arm is provided with a gas strut operating through a connecting mechanism for counterbalancing the force of gravity. The connecting mechanism comprises two parallelogram guideances, each including a rod linked by a common guide element to which the gas strut is also connected. The guide element rotates about an axis which is fixed with respect to the arm and is parallel to the axes of rotation of the mount-arm

and arm/attaching means pivots. This results in a vertical disposition of the gas strut and at least one rod so that, the resulting structure is relatively bulky.

The object of the present invention is to provide a support for locating an object or objects of appreciable weight at an adjustable height which support is compact, and allows a large range of vertical movement such that the object may be located close to, or distant from a reference height, or at any intermediate height.

This object is met and the disadvantages of the prior art are overcome by the support in accordance with the present invention. This support comprises a mount which, in use, is located at a reference height. A crank extends from this mount. A boom is pivotally mounted on the mount and extends therefrom to and carries means for attaching the object which is to be located at an adjustable height with respect to the reference height. A lift mechanism comprises a lift lever and a gas strut which are carried wholly by the boom. The lift mechanism also comprises a lift rod which is mounted between the lift lever and a position on the crank remote from the mount/boom, the latter being pivotally mounted in the boom about a lift lever/boom axis fixed relative to the boom. The lift rod and the gas strut are pivotally connected to the lift lever. The gas strut engages the boom and counteracts the effects of gravity when the support is loaded with the intended object.

In accordance with a first aspect of the invention, the axis of rotation of the lift lever (ie the lift lever/boom axis) is arranged to be substantially orthogonal to the mount/boom axis. This enables the lift mechanism to be arranged more compactly within a substantially flat boom with the lift lever and lift rod in a side-by-side as opposed to a vertical relative disposition. When the boom is horizontal, the lift mechanism therefore lies substantially within a horizontal plane. It is thus possible to achieve a compact design in which the whole lifting mechanism is contained out of sight within the boom. Also, a large range of vertical adjustment can be achieved with the object being supported very close to or distant from the reference height or at any intermediate height.

In accordance with a second aspect of the invention, the lift rod and the gas strut are connected to the lift lever with the strut at a greater separation from the lift lever/boom axis than the rod. This arrangement provides a mechanical advantage which allows the use of a relatively small and inexpensive gas strut which in turn allows for a more compact design of the support than would otherwise be possible, which in turn allows for a design permitting a great range of vertical positions to be obtained.

By careful choice of the positions at which the gas strut is connected to the boom and to the lever and the positions at which the lift rod is connected to the base crank, it is possible to make optimum use of the gas strut characteristics so as to provide the correct lifting force needed over the full range of vertical positions. It is also possible, with a single basic design, to accommodate objects having a wide range of weights and weight distributions. Flexibility is possible because of the interchangeability of gas struts having different pressures and can be enhanced by providing a plurality of optional connecting positions for the gas strut and the lift rod.

5 The support can be provided with a platform for mounting the object on the boom and with a parallel motion linkage so that the platform remains at its original orientation during movement of the boom. This parallel linkage is preferably provided with a tilt mechanism to allow the platform to be set at a desired angle with respect to the base mount. This angle is maintained constant during movement of the boom by the parallel linkage.

10 The support can be provided with a platform for mounting the object on the boom and with a parallel motion linkage so that the platform remains at its original orientation during movement of the boom. This parallel linkage is preferably provided with a tilt mechanism to allow the platform to be set at a desired angle with respect to the base mount. This angle is maintained constant during movement of the boom by the parallel linkage.

15 The present invention will be further described hereinafter with reference to the accompanying drawings in which:

20 Figure 1 is a general side view of an embodiment of the invention for supporting a CRT display;

25 Figure 2 is an isometric view of part of the support of Figure 1 including details of the basic lifting mechanism;

30 Figures 3a and 3b, 4a, 4b, 4c and 4d, 5a and 5b, 6a, 6b and 6c are used to explain the operation of the lifting mechanism of Figure 2;

35 Figure 7 is a plan view of a combined lifting and parallel motion mechanism for use in the support of Figure 1;

40 Figure 8 is a side view of the support of Figure 1 indicating in general terms how the mechanism of Figure 7 can be accommodated within the boom;

45 Figure 9 is a plan view of a tilt mechanism for use in the support of Figure 1;

50 Figure 10 is a side view of the support of Figure 1 indicating in general terms how the mechanism of Figure 7 and that of Figure 9 can be accommodated in the boom and in the platform respectively;

55 Figures 11a, 11b and 11c are used to explain the operation of the tilt mechanism of Figure 9;

Figure 12 is a plan view of a combined lift, parallel motion and tilt mechanism for use in the support of Figure 1; and

Figure 13 is a side view of the support of Figure 1 indicating in general terms how the mechanism of figure 12 can be accommodated within the boom.

Figure 1 shows a general view of apparatus for supporting a CRT display device which is constructed in accordance with the present invention.

The supporting apparatus comprises a mount, or base 10, a boom 12 and a platform 14. A CRT display 100 is attached to the platform.

As can be seen in Figure 2, the boom is generally box-shaped in cross-section, and is wider than it is tall. The boom is formed at its lower end with two downward facing lugs 15, one at each side of the lower end of the lift boom. It is by means of these lugs 15, which pass through slots 16 in the base, that the boom is hinged to the mount about an axis 18 which is approximately horizontal in use. Conveniently, as will be apparent to the skilled person, the lugs 15 are placed wide apart along the axis 18 in order to enhance the torsional stability of the boom. The mount is formed with two upward facing lugs, forming a crank 20, which pass through a slot 22 in the lower surface of the boom.

Contained within the casing 13 of the boom is a lift mechanism comprising a lift lever 26, a lift gas strut 30 and a lift rod 36. One end of the lift lever 26 is pivotally mounted in the boom to rotate about an axis 28 at a fixed location in the boom. The axis 28 is substantially orthogonal to the mount/boom axis 18. This means that the lift mechanism can be contained in a compact manner within the boom, with the lift lever, lift rod and gas strut lying substantially within a plane which is parallel to, and rotates about, the mount/boom axis. The lift lever/boom axis is perpendicular to this plane. The gas strut 30 is pivotally connected to a point 32 at the other end of the lift lever 26 and is pivotally connected to position 34 in the lift boom. The lift rod 36 is pivotally connected at one end to the crank 20, at a position 38 displaced from the mount/boom axis 18, and is pivotally connected at the other end to a point 40 on the lever 26 intermediate the pivot 28 and the connecting point 32 for the gas strut 30. A cover (not shown) for the casing of the boom is provided so that the lift mechanism is concealed within the boom and to increase the rigidity and torsional stability of the boom. The cables (not shown) for the CRT display can be carried within the boom casing.

Figures 3a and 3b are useful in explaining the operation of the lift mechanism.

In a first position of the boom, at an angle θ to the horizontal, the distance between the point 38 at which the lift rod 36 is connected to the crank 20 and a predetermined position 42 in the boom, say the end of the boom, is X . In a second position of the boom, at an angle $\theta + \Delta\theta$ to the horizontal,

after a rotation $\Delta\theta$ about the mount/boom axis 18, the distance between the point 38 and the predetermined position 42 has increased to $X + \Delta X$. Clearly, if no biasing force is provided to counteract the weight of the display (not shown), mounted at the other end of the boom, the boom will tend to rotate in a clockwise direction (as seen in Figures 3a and 3b) about the hinge 18. The gas strut 30, lift lever 26 and lift rod 36 exert a biasing force F between the point 38 and the position 34 at which the gas strut is mounted in the boom, to tend to cause the boom to rotate in a counter-clockwise direction (as seen in Figures 3a and 3b) about the hinge 18. The use of an arrangement of gas strut, lift lever and lift rod allows for the biasing force exerted to counter-balance the weight of the display over the complete range of operating heights as explained below.

The relative distances of the connecting points 32 and 40 of the gas strut 30 and the lift rod 36 from the pivot 28 on the lift lever 26 mean that a less powerful gas strut can be used than would be possible if a gas strut were to provide the lifting force directly. Thus the mechanical advantage of the primary linkage comprising the lift lever 26 allows a relatively small and compact gas strut to be used, while the mechanical disadvantage of the boom nevertheless allows for a wide range of heights to be selected for the display.

The advantages of using gas struts rather than springs are manifold. Compared to springs, gas struts can be supplied with a wider range of output forces for a given diameter or barrel size. The range of "rates" (ratio of forces in the compressed, over the extended conditions - thus a gas strut "rated" at 1.5 and 100N would exert 100N when fully extended and 150N when fully compressed) which are obtainable in a given diameter or barrel size is also better than that for springs. Also damping (controlled extension speed) can be provided using gas struts by incorporating a simple valve and/or oil in the barrel.

The present invention allows these advantages to be exploited.

The point at which the gas strut is connected to the lift lever can be used to adapt the "rate" of the gas strut to the requirements of a particular arrangement. For example, if a gas strut 30 rated at 1.3 is operative over a 100 mm stroke S as shown in Figure 4a, one can talk of a "system-rate" of 1.3. If, however, the particular display set-up only requires a "system rate" of 1.15, the gas strut can be connected to the lift lever 26 at a position 32' where it used only 50 mm of its stroke $S'2$ as shown in Figure 4b. With this in mind the lift lever could be provided with a plurality of optional connecting points 32, 32', 32" for the gas strut.

By changing the position at which the gas strut is connected to the lever, and consequently changing the working ratio of the lever mechanism, it is possible to support a range of displays having different weights with a single gas strut. Instead of providing a plurality of locations at fixed positions for connection of the gas strut as shown in Figures 4a and 4b, it would also be possible to provide a continuously variable connection arrangement.

Figures 4c and 4d show such an arrangement where the upper 26a and lower 26b surfaces of the lift lever 26 are formed with slots 27a and 27b. A pin 32 is mounted in the slots on a screw 33 such that on turning the screw the pin is moved along the slots. The screw is rotatably mounted at one end in a bearing 29. In order to correctly locate the pin in the slots, and to connect the gas strut thereto, the gas strut is formed with a double fork 31.

The system performance can also be changed by the selection of the start and finish angles α (Fig. 5a) of the gas strut 30 relative to the lift lever 26 as it rotates about the pivot point 28. The optimum driving force transmission is obtained when the gas strut is perpendicular to the lift lever (ie $\alpha = 0^\circ$). As α increases the effective driving force decreases, as this is given by $F \cos \alpha$; where F is the driving force of the gas strut at any particular extension. Thus it can be seen that the effective driving force can be maximised at a particular portion of the gas strut's stroke by arranging for the gas strut to be perpendicular to the lift lever at that portion of the stroke and the performance of the strut can be 'tuned' to system requirements. In view of this a plurality of optional connecting positions 34, 34', 34'', ... could be provided in the boom (see Figure 5b) for the end of the gas strut not connected to the lift lever.

The system can also be tuned by the selection of the angle β between the axis of the lift rod 36 and an imaginary line 42 joining the mount/boom axis 18 to the position 38 at which the lift rod is connected to the crank 20 (see Fig. 6a). If Y is the distance from the lift rod axis to the mount/boom axis 18, then the effective pulling distance of the lift rod, when the boom 12 is rotated with respect to the base 10 about the mount/boom axis 18, is $Y \sin \beta$ (see Fig. 6b). The maximum effect is therefore obtained when $\beta = 90^\circ$, ie when the lift rod is perpendicular to the aforementioned imaginary line 43 as in Fig. 6a. By choosing the relative positions of the mount/boom axis 18 and the connecting point of the lift rod 36 to the crank 20, it is possible to further tune the system. To this end a plurality of optional connection positions 38, 38', 38'', ... for the lift rod 36 could be provided on the crank (see Fig. 6c).

Thus the lever arrangement of the support in accordance with the present invention provides more opportunities than conventional arrangements to optimise the lifting force over the complete range of operating heights.

As the angle of the boom to the horizontal changes in operation as the display is lifted, it is desirable that a mechanism is provided for maintaining the display at a desired viewing angle. Figures 7 and 8 show a simple arrangement for providing this feature. The boom is provided at its upper end with two upward facing lugs 44 which pass through slots (not shown) in the display platform 14. The platform could be generally plate-like, but could alternatively have a shape adapted to suit particular displays to be mounted thereon. Indeed, the platform could be formed integrally with the display housing. If the display is separate from the platform, the skilled person will be aware that suitable securing means should be provided to fix the display on the platform when in use. It is by means of these lugs 44 that the platform is hinged to the lift boom about a boom/platform axis 46 which is parallel to the mount/boom axis 18. It is the boom therefore that carries the platform. The skilled person will realise that the stability of the structure is enhanced by placing the lugs 46 as wide apart as possible along the axis 48. The platform is also formed with downward facing lugs 48 for providing a platform crank 48 which pass through a hole (not shown) in the upper surface of the boom. As shown in Figure 7, the lift lever 26 of Figure 2 is modified to provide an extension beyond the pivot point 28. A parallel motion linkage in the form of a parallel motion rod 52 is connected between a pivotal connection point 54 on the extended lift lever 26' and a pivotal connection at a position 56 on the platform crank 48. The locations of the point 54 and the position 56 are so chosen to maintain the platform, and consequently the display, at a constant orientation to the horizontal. If, for example, the distance between the connecting position 38 of the lift rod to the base lugs and the mount/boom axis 18, and the distance between the connecting position 56 of the parallel motion rod to the platform crank and the boom/platform axis 46 are so chosen to be equal, at any particular angle of the boom, then the connecting points 40 and 54 should be equidistant from, but on opposite sides of the pivot point 28. With a combined lift and parallel motion mechanism the lift force required from the lift gas strut is unaffected by changing the position of the centre of gravity of the display. Figure 8 illustrates how the lift and parallel motion mechanisms are contained within the boom with the com-

bined mechanism lying substantially within a plane which is parallel to, and rotates about the mount/boom axis. As can be seen, the axis lift lever/boom axis is perpendicular to this plane.

It is also desirable to provide a tilt mechanism for the display so that the viewing angle can be changed irrespective of the boom inclination. This could be done by providing a mechanism which is completely independent of the lift and parallel motion mechanism. However, the tilt mechanism can also be combined with the lift and parallel motion mechanism as illustrated hereinafter with reference to two alternative arrangements.

In one of those arrangements, shown in Figures 9 and 10, the tilt mechanism is housed in the platform 14. In this arrangement the platform lugs 48 (Figures 7 and 8) are replaced by an idler arm 58 which is pivotally mounted to rotate about the boom/platform axis 46. In practice the idler arm 58 remains more or less vertical while the angles of the boom and the platform change. The parallel motion rod 52 (cf. Figure 7) is pivotally connected to the lower end of the idler arm at a position 60 displaced from the boom/platform axis 46. A tilt rod 62 is pivotally connected to the other end of the idler arm at a position 64, the connecting positions 60 and 64 relative to the boom/platform axis being chosen such that the platform maintains the orientation set, as the boom angle changes.

The tilt mechanism, which comprises the tilt rod 62, a tilt lever 66 mounted about an axis 70 and a tilt gas strut 68, operates in essentially the same way as the corresponding lift mechanism comprising the lift rod 36, lift lever 26 and the gas strut 30. For example the axis 70 is at a fixed location within the platform and is substantially orthogonal to the boom/platform axis 46. The operation of the tilt mechanism will therefore not be described in further detail. A brief explanation of the forces produced when a display is tilted is, however, given below with reference to Figures 11a, 11b and 11c.

Figures 11a and 11b show a display at 0° and 20° tilt respectively. This is a typical requirement of display users. If L is the horizontal distance at 0° tilt (Figure 11a) of the display's centre of mass from the axis 46 about which the display pivots and $L + \Delta L$ is the corresponding distance at 20° tilt (Figure 11b), then the turning moment =

$$M \cdot L \text{ at } 0^\circ \text{ and} \\ M \cdot (L + \Delta L) \text{ at } 20^\circ$$

(where M is the mass of the display).

The force diagram gradient shown in Figure 11c therefore has to be matched closely by the tilt linkage mechanism (including the tilt gas strut) output forces. In order to achieve this, the tilt

linkage mechanism is set up bearing in mind the various aspects discussed for the lift mechanism with respect to Figures 3a to 6c. Thus the tilt mechanism could include a plurality of optional connecting points for the tilt rod and the tilt gas strut on the idler arm, on the tilt lever and in the platform, as appropriate. Although the horizontal distance between the display's centre of mass and the axis 46, and accordingly the turning moment, varies according to a cosine rule $\Delta L \propto R \cos \gamma$ (R = distance from the axis to the centre of mass and γ = the angle of an imaginary line between the axis and the centre of mass to horizontal), the turning moment curve can be considered to be approximately linear where the total angle swept due to display adjustment does not exceed 25° and the angle γ is within the range 20° to 60°. Outside this range special gas struts with high rates would be required.

The other of the aforementioned arrangements comprising a lift, a parallel motion and a tilt mechanism is described with reference to Figures 12 and 13. This arrangement is particularly compact as the lift, parallel motion and tilt mechanisms are all integrated in the boom. The combined mechanism is located substantially in a plane which is perpendicular to and rotates about the mount/boom and boom/platform axes. It can be seen in Figure 12 that the mount/boom and boom/platform axes as well as the aforementioned plane are parallel to the plane of the paper. In Figure 13 these axes are perpendicular to the plane of the paper. The aforementioned plane extends generally between the mount/boom and boom/platform axes (but does not pass through them) and perpendicular to the plane of the paper. The lift gas strut 30 is pivotally connected at one end to a predetermined position 34' in the boom 12 and is pivotally connected at the other end to a point 32 on the lift lever 26'. The lift lever 26', which is mounted about an axis 28 fixed with respect to boom 12, is pivotally connected to one end of the lift rod 36, whose other end is connected at a position 38 to the base crank 20. It can be seen in Figures 12 and 13 that the axis 28 is perpendicular to the aforementioned plane and orthogonal to the mount/boom and boom/platform axes 18 and 46. In Figure 12 the axis 28 is perpendicular to the plane of the paper, and in Figure 13 it lies in the plane of the paper along the dot-dash line. The lift lever 26' is also connected to a combined parallel linkage and tilt mechanism at the point 54. As discussed with reference to Figures 7 and 8, the relative positions of the connection points 54 and 40 with respect to the pivot point 28 of the lift lever will be dependent on other related dimensions.

The parallel linkage and tilt mechanism comprises a slider plate 82 a tilt gas strut 68', a tilt lever 66' which is provided with a hollow portion 96 for the passage of the lift rod 36, and a tilt rod 62'. The tilt lever 66' is pivotally mounted at a fixed location 70' on the slider plate 82. Studs 76, which engage slots in the slider plate, are provided in the boom for guiding the plate.

The tilt gas strut 68' is pivotally connected at one end to a predetermined point 72' on the tilt lever 66' and is further connected at the other end to a predetermined position on the slider plate 82, which in this specific arrangement is the position at which the lift lever is connected to the slider plate. The tilt rod 62' is connected between a predetermined pivotal connection point 74' on the tilt lever 66' and a pivotal connection at a predetermined position 56 on the platform crank 48. The tilt rod passes through a hollow portion 94 of the lift lever 26". As can be seen in Figures 12 and 13, the axes 28 and 70' are parallel to each other. In this arrangement the platform 14 is the same as that shown in Figure 8. A continuously variable mechanism such as that shown in Figures 4c and 4d can be provided for either or both of the lift lever and the tilt lever for adjusting the point at which the lift and tilt gas struts are connected to their respective levers.

The lift mechanism and the tilt mechanism are both balanced systems in their own right, and due to the inherent stiffness of the mechanisms they operate independently of one another.

To raise the display height the operator merely has to apply a slight upward force on the display to "lighten the load" on the system and to temporarily take the lift mechanism out of balance. The effect of this is that the lift gas strut 30 extends under its internal pressure. The lift lever 26" is thereby allowed to rotate anti-clockwise (as seen in Fig. 12) about the pivot point 28 forcing the slide plate 82 to the right as seen in that Figure. As the tilt mechanism is in balance with the display at its current tilt angle and as the tilt mechanism is mounted on the slide plate 82, the tilt mechanism moves with the slider causing the tilt rod to act on the platform 14 to maintain the desired tilt angle (ie the tilt mechanism and the slide plate act together as a parallel linkage). When the user releases the display (ie when he ceases to exert an upward force) the display stays at the desired height because the lift system is once more balanced. To lower the display height the operator merely applies a slight downward force on the display until the desired height is reached.

If the user applies a force so as to tilt the display about the second axis 46, this changes the rotational force and takes the "tilt system" out of balance. The extension of the tilt gas strut changes

accordingly. When the user releases the display the tilt system is balanced in the new position. As this balancing of forces, takes place within the tilt mechanism (tilt rod 62', tilt lever 66' and tilt gas strut 68') on the slide plate, the slide plate 82 and the balanced lift mechanism do not move.

In all of the described embodiments the mount/boom and boom/platform axes would normally, in use, be substantially horizontal.

Figure 12 also shows a locking mechanism for the lift, tilt and parallel motion mechanisms. This comprises a locking plate 78 which is connected to the tilt lever 66' at 84 and is formed with a slot 86. The lift lever 26" is also provided with an integral slotted extension 92. Passing through the slots in the locking plate and the extension is a screw 88 which is connected to a locking lever 90. On operating the locking lever 90 the screw urges the plate 76 and the slotted extension 92 against a locking collar 91 formed in the lift boom 12. As the lift and tilt mechanisms are balanced, only light forces are needed to lock the support apparatus in a desired position.

Although the present invention has been described with respect to variants of a specific embodiment, it will be understood that further modifications and/or additions are possible without departing from the claimed subject-matter.

In the embodiment of Figures 12 and 13 for example, the slide-plate 82 could be replaced by a suitably shaped rod connecting the points 54 and 70' and slidably mounted in the lift-boom 12.

The platform 14 could form an integral part of the display device's housing.

The apparatus could additionally be provided with a swivel mechanism. This could, for example, take the form of a turntable which forms part of the base mount 10, or to which the mount is connected. Alternatively, or additionally, the base mount could be in the form of an edge clamp to further reduce the footprint of the apparatus.

Instead of a base mount with a boom and platform arrangement for supporting an object above the base mount, the support could comprise a mount which is for fixing to a wall or ceiling with the boom depending therefrom (ie a support which is essentially an inverted form of that so far described). As in the embodiments particularly described, the lift mechanism would be so arranged to urge the boom into its raised position, although in this alternative embodiment that would be the near-horizontal position. The lifting force would be so adjusted to counteract the downward force of gravity acting on the object (eg a CRT display) attached to a platform at the lower end of the boom, which downward force would urge the boom towards the near-vertical position. To adapt the lever mechanisms particularly described to provide

a force which urges the boom to a near horizontal position is considered to be within the scope of the skilled person. This could be achieved, for example, by attaching the lift gas strut 30 and the lift rod 36 to the lift lever 26 shown in Figure 2, at opposite sides rather than on the same side of the pivot 28.

It should be understood that the present invention, although particularly described with reference to a display device, is not limited to the supporting of such a device.

Claims

1. A support, intended in operation to locate an object of appreciable weight at an adjustable height relative to a reference height, the support including:

a mount (10) to be located at the reference height and having a crank (20) extending therefrom;

a boom (12) pivotally mounted on said mount about a mount/boom axis and extending therefrom to, and carrying, means for attaching the intended object; and

a lift mechanism comprising:

a lift lever (26; 26'; 26'') and a lift gas strut (30) carried wholly by the boom; and

a lift rod (36) mounted between the lift lever and a position on the crank remote from the mount/boom axis,

the lift lever being pivotally mounted about a lift lever/boom axis which is substantially orthogonal to the mount/boom axis and is fixed relative to the boom, and the lift rod and the lift gas strut both being connected to the lift lever,

the lift gas strut engaging the boom and counteracting the effects of gravity when the support is loaded with the intended object.

2. A support as claimed in claim 1 wherein the lift rod and the lift gas strut are connected to the lift lever with the strut at a greater separation from the lift lever than the rod.

3. A support, intended in operation to locate an object of appreciable weight at an adjustable height relative to a reference height, the support including:

a mount (10) to be located at the reference height and having a crank (20) extending therefrom;

a boom (12) pivotally mounted on said mount

about a mount/boom axis and extending therefrom to, and carrying, means for attaching the intended object; and

5 a lift mechanism comprising:

a lift lever (26; 26'; 26'') and a lift gas strut (30) carried wholly by the boom; and

10 a lift rod (36) mounted between the lift lever and a position on the crank remote from the mount/boom axis,

the lift lever being pivotally mounted about a lift

15 lever/boom axis fixed relative to the boom, and the lift rod and the lift gas strut both being connected to the lift lever but with the strut at a greater separation from the lift lever/boom axis than the rod,

20 the lift gas strut engaging the boom and counteracting the effects of gravity when the support is loaded with the intended object.

4. A support as claimed in any one of the 25 preceding claims wherein the lift mechanism lies substantially within a plane which is parallel to the mount/boom axis.

5. A support as claimed in any one of the preceding claims wherein the attachment means comprise a platform (14) for mounting the intended object, the platform being directly carried by and pivotally mounted on the boom about a boom/platform axis, which is substantially parallel to the mount/boom axis, and being connected to a parallel motion mechanism.

30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 2230 2235 2240 2245 2250 2255 2260 2265 2270 2275 2280 2285 2290 2295 2300 2305 2310 2315 2320 2325 2330 2335 2340 2345 2350 2355 2360 2365 2370 2375 2380 2385 2390 2395 2400 2405 2410 2415 2420 2425 2430 2435 2440 2445 2450 2455 2460 2465 2470 2475 2480 2485 2490 2495 2500 2505 2510 2515 2520 2525 2530 2535 2540 2545 2550 2555 2560 2565 2570 2575 2580 2585 2590 2595 2600 2605 2610 2615 2620 2625 2630 2635 2640 2645 2650 2655 2660 2665 2670 2675 2680 2685 2690 2695 2700 2705 2710 2715 2720 2725 2730 2735 2740 2745 2750 2755 2760 2765 2770 2775 2780 2785 2790 2795 2800 2805 2810 2815 2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870 2875 2880 2885 2890 2895 2900 2905 2910 2915 2920 2925 2930 2935 2940 2945 2950 2955 2960 2965 2970 2975 2980 2985 2990 2995 3000 3005 3010 3015 3020 3025 3030 3035 3040 3045 3050 3055 3060 3065 3070 3075 3080 3085 3090 3095 3100 3105 3110 3115 3120 3125 3130 3135 3140 3145 3150 3155 3160 3165 3170 3175 3180 3185 3190 3195 3200 3205 3210 3215 3220 3225 3230 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4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 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9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9795 9800 9805 9810 9815 9820 9825 9830 9835 9840 9845 9850 9855 9860 9865 9870 9875 9880 9885 9890 9895 9900 9905 9910 9915 9920 9925 9930 9935 9940 9945 9950 9955 9960 9965 9970 9975 9980 9985 9990

a tilt rod (62') mounted between a position on the platform crank remote from the boom/platform axis and the tilt lever, the tilt lever being pivotally mounted about a tilt lever slide member axis fixed relative to the slide member, and the tilt rod and the tilt gas strut both being connected to the tilt lever, the tilt gas strut engaging the slide member and counteracting the turning moment caused by weight of the intended object when loaded on the platform.

8. A support as claimed in claim 7 wherein the tilt lever/slide member axis is substantially parallel to the lift lever/boom axis.

9. A support as claimed in claim 7 or claim 8 wherein the tilt rod and the tilt gas strut are connected to the tilt lever with the tilt gas strut at a greater separation from the tilt lever/slide member axis than the tilt rod.

10. A support as claimed in any one of claims 7 to 9 wherein the parallel motion mechanism and the tilt mechanism also lie substantially within said plane which is parallel to the mount/boom axis.

11. A support as claimed in any one of claims 7 to 10 comprising a locking mechanism (78, 86, 88, 90, 91, 92) for locking the support in use with the object located at an intended height and with an intended inclination.

12. A support as claimed in claim 11 wherein the locking mechanism comprises a locking plate (78) which is pivotally connected to the tilt lever and is formed with a slot (86), an integral slotted extension (92) to the lift lever (26'), a locking collar (91) which is formed in said lift boom, a clamp mechanism (88) which extends through the slots in the locking plate and the slotted extension to the lift lever, and an actuator (90) which, on manual operation thereof, causes said clamp mechanism to clamp the locking plate and the extension to the lift lever to the locking collar.

13. A support as claimed in claim 6 wherein the platform crank means comprises an idler crank arm (58) which is rotatably mounted about the boom/platform axis and wherein the platform is provided with a platform tilt mechanism comprising:

a platform tilt lever (66) and a platform tilt gas strut (68) carried wholly by the platform; and

a platform tilt rod (62) mounted between a position on the idler crank remote from the boom/platform axis and the platform tilt lever, the tilt lever being pivotally mounted about a platform tilt lever/platform axis (70) fixed relative to the platform, and the platform tilt rod and the platform tilt gas strut both being connected to the platform tilt lever, the platform tilt gas strut engaging the

platform and counteracting the turning moment caused by the weight of the intended object when loaded on the platform.

5 14. A support as claimed in claim 13 wherein the platform tilt lever/platform axis is substantially orthogonal to the boom/platform axis and wherein the platform tilt mechanism lies substantially within a plane which is parallel to the boom/platform axis.

10 15. A support as claimed in claim 13 or claim 14 wherein the platform tilt rod and the platform tilt gas strut are connected to the platform tilt lever with the platform tilt gas strut at a greater separation from the platform tilt lever/platform axis than the platform tilt rod.

16 16. A support as claimed in any one of the preceding claims wherein a plurality of optional mounting points for one or more of the gas struts are provided on the elements with which it or they co-operate.

20 17. A support as claimed in any one of the preceding claims wherein the position at which a gas strut is connected to its co-operating lever is continuously adjustable along part of the length of said lever.

25 18. A support as claimed in any one of the preceding claims wherein a plurality of optional predetermined connecting positions (34, 34', 34", ...) for said lift gas strut are provided in said lift boom.

30 19. A support as claimed in any one of the preceding claims wherein the base crank comprises a plurality of optional connecting positions (38, 38', 38", ...) displaced from the mount/boom axis for the lift rod and/or said platform crank means comprises a plurality of optional connecting positions displaced from the boom/platform axis for the tilt lever or platform tilt lever as appropriate.

35 20. A support as claimed in any one of the preceding claims wherein the intended object is a display device (100).

40 21. A support as claimed in any one of the preceding claims in combination with a display device.

45 22. A support substantially as shown in the accompanying drawings.

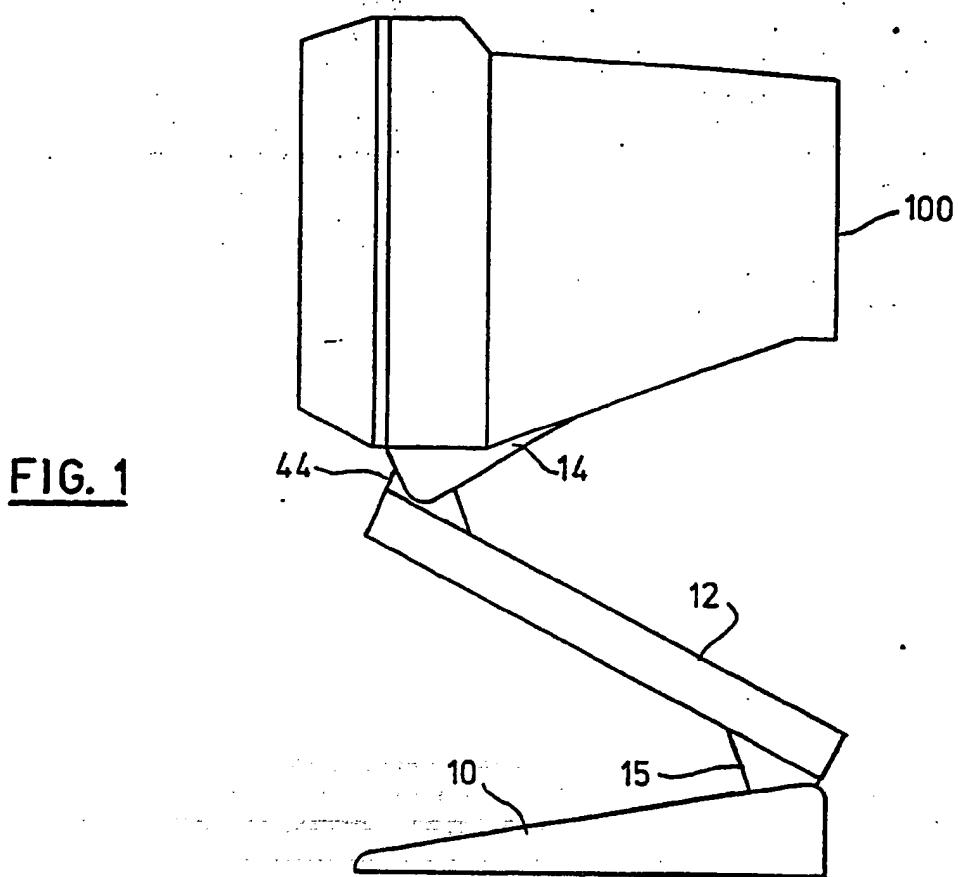


FIG. 1

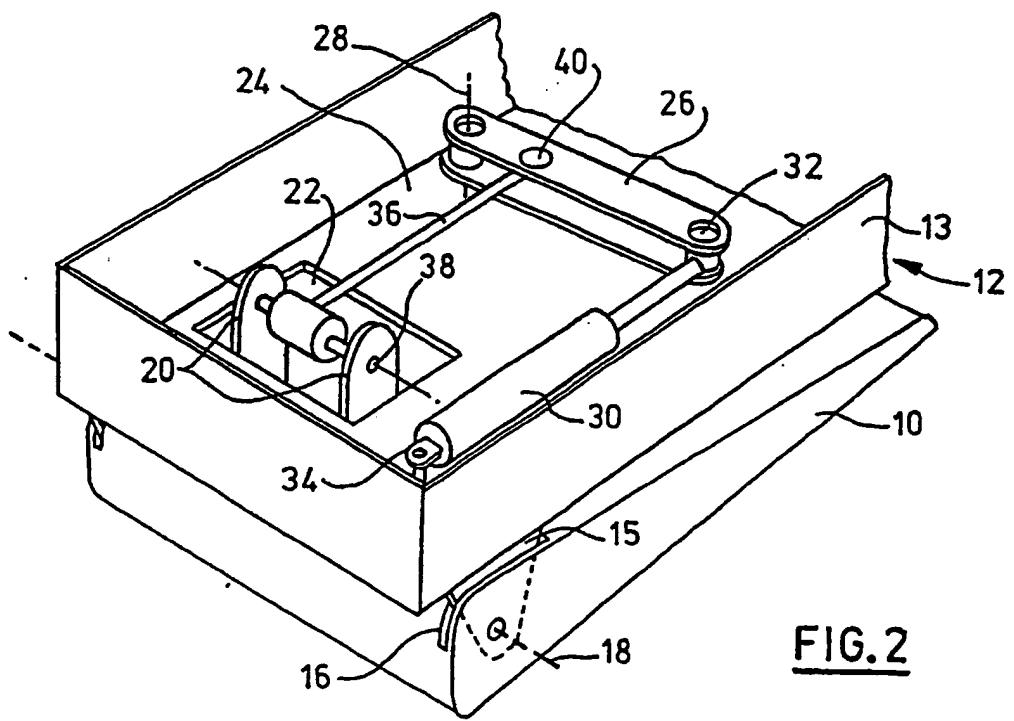


FIG. 2

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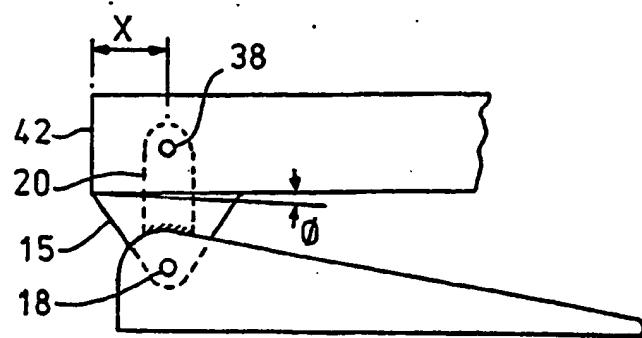


FIG. 3a

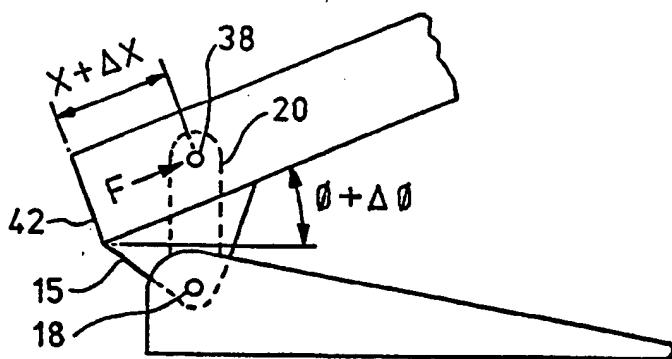


FIG. 3b

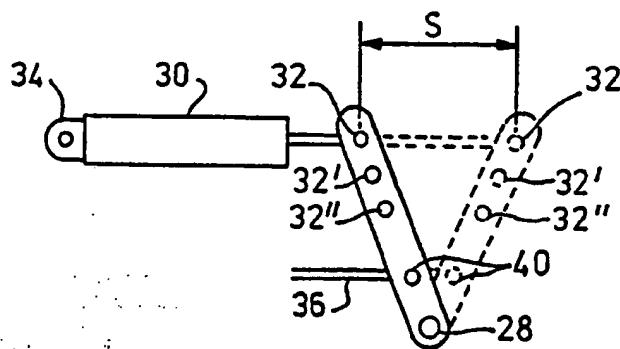


FIG. 4a

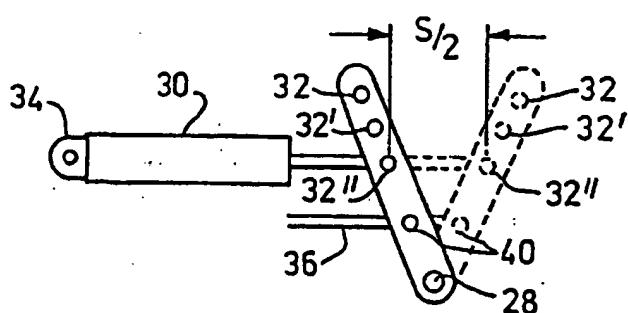
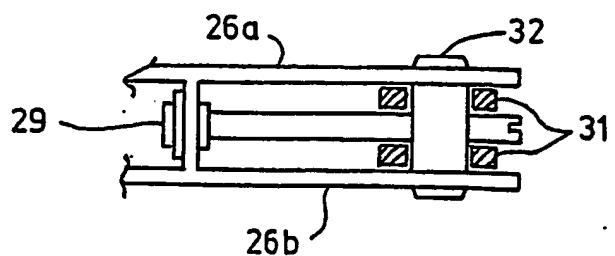
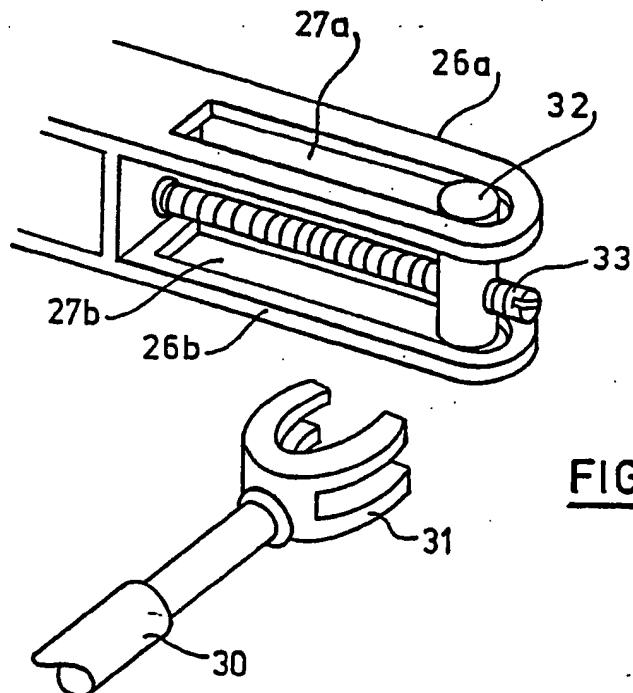
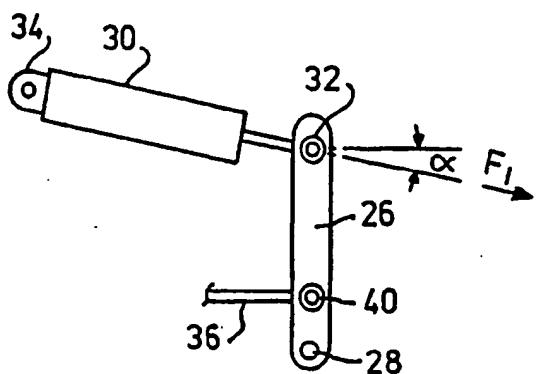
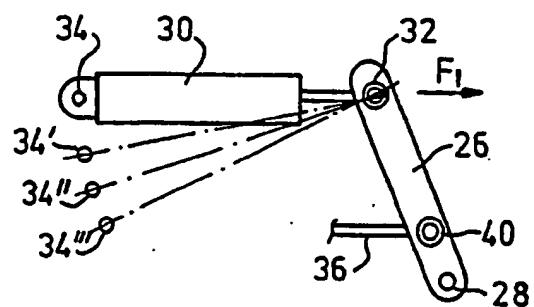
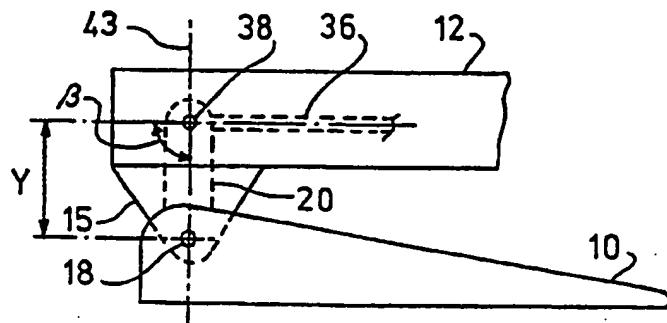
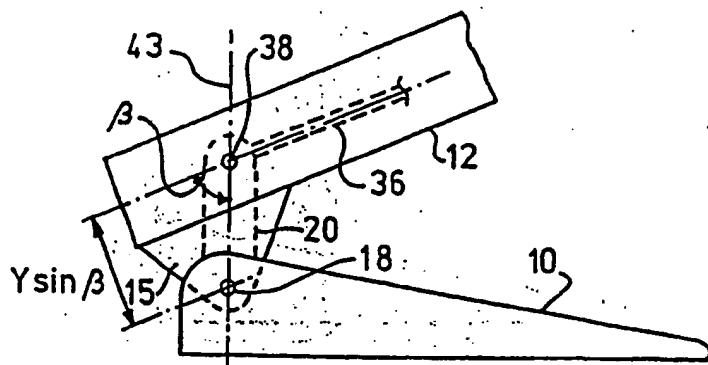
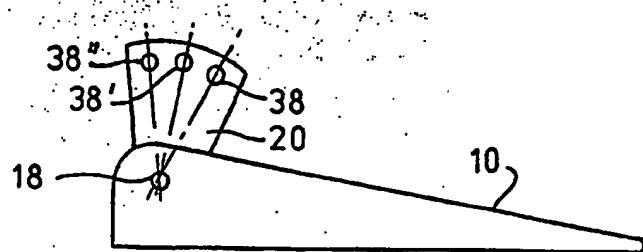


FIG. 4b



FIG. 5aFIG. 5bFIG. 6aFIG. 6bFIG. 6c

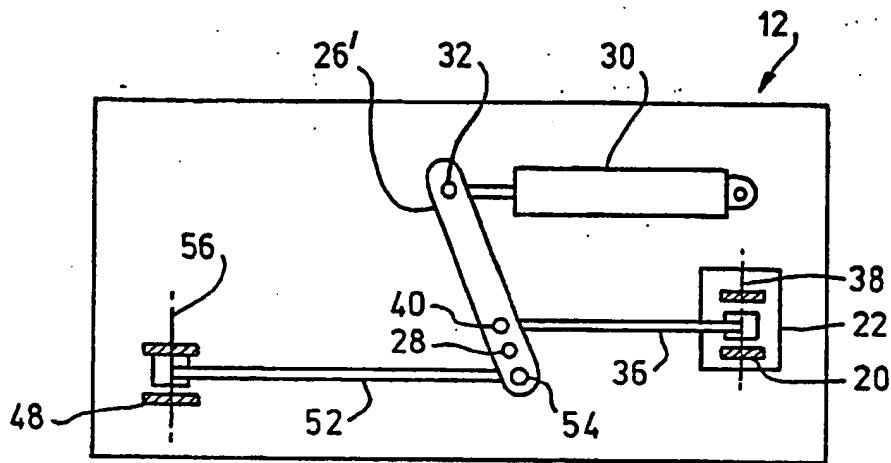


FIG. 7

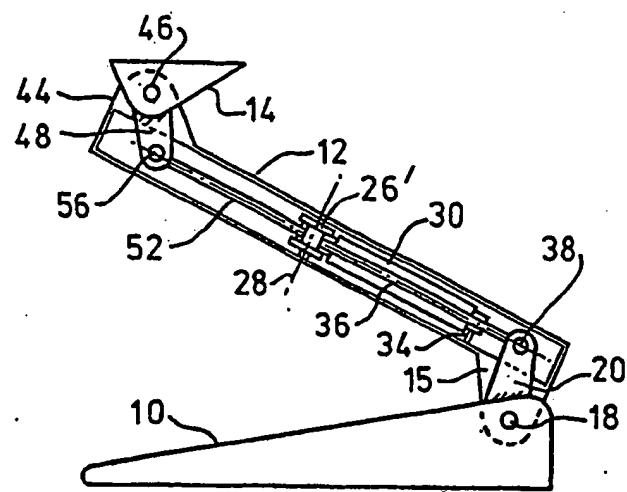


FIG. 8

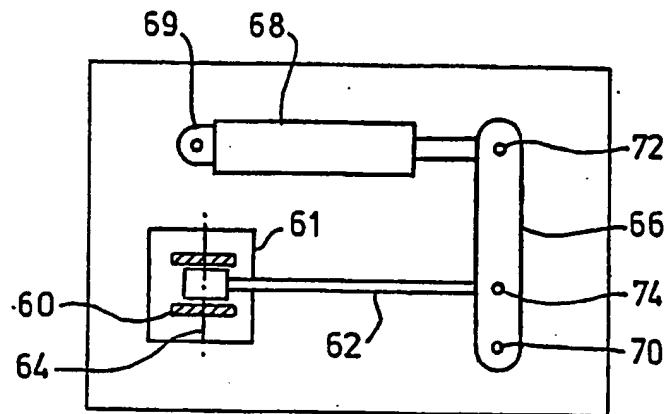


FIG. 9

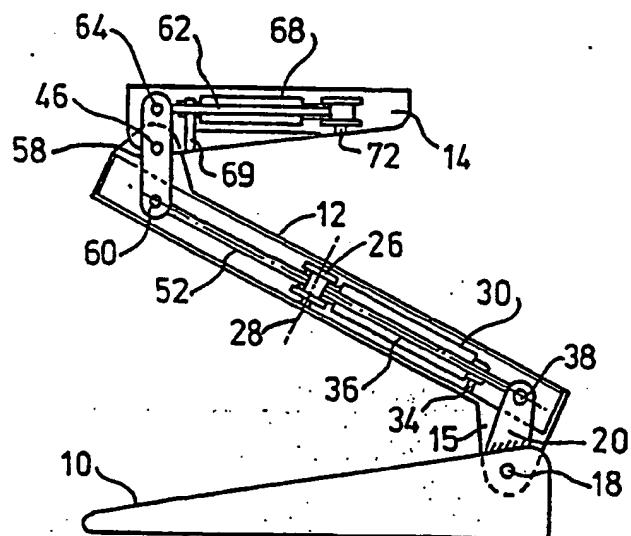
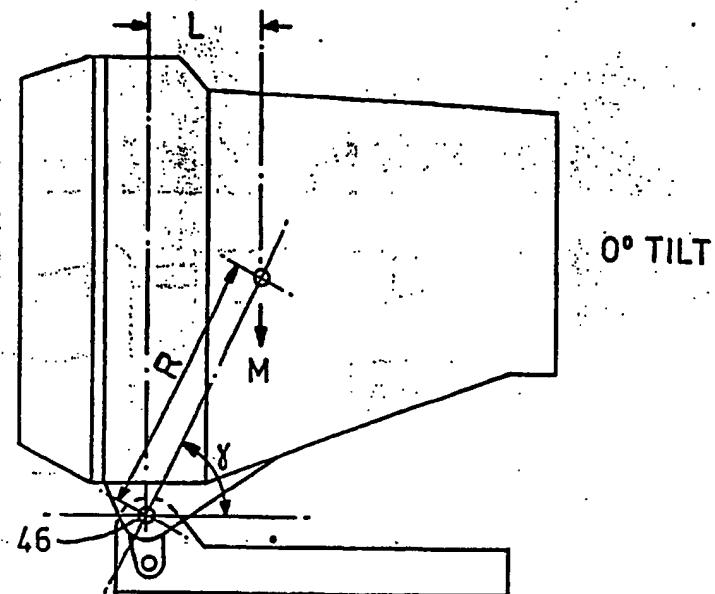
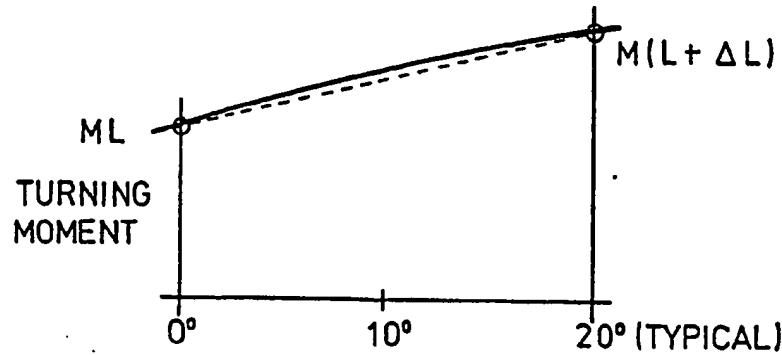
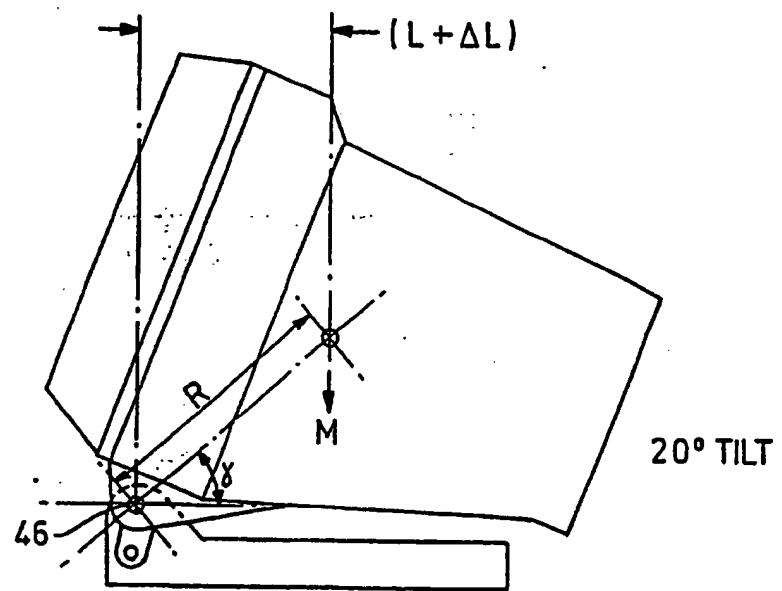


FIG. 10

FIG.11aFIG.11bFIG.11c

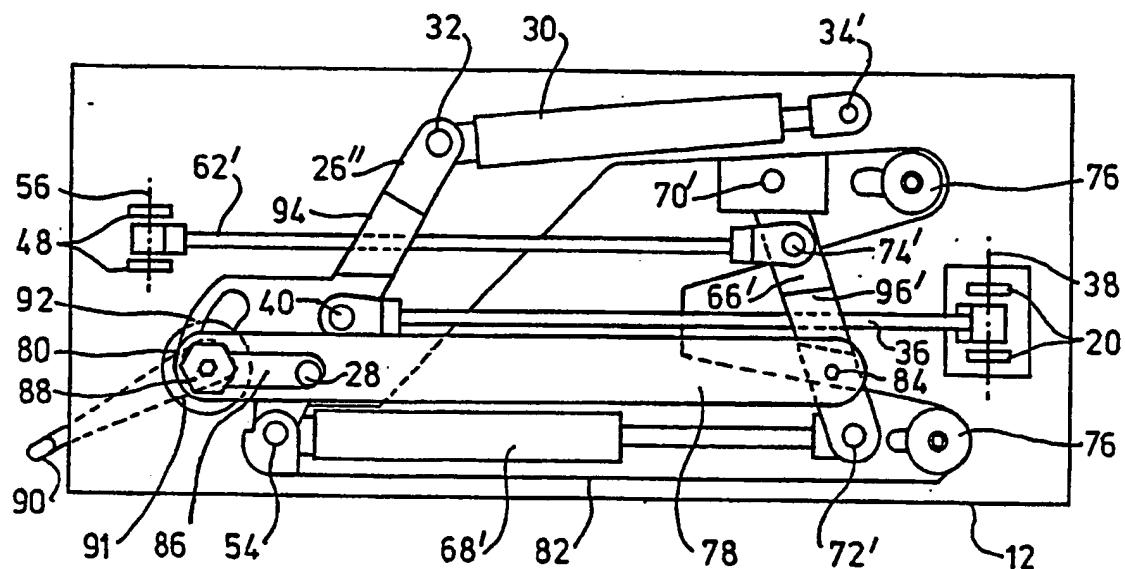


FIG. 12

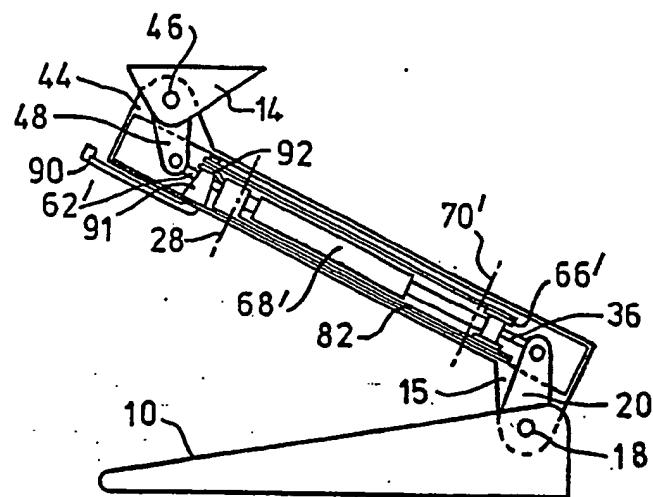


FIG. 13

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